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ABSTRACT

This study compared the effects of two methods of presenting instructive feedback during direct instruction on the learning of four preschool students with language delays and one with hearing impairments. These methods involved presenting two extra stimuli on all trials, and presenting the two extra stimuli separately on alternating trails. The students were taught coin combinations using a constant time delay procedure with instructive feedback stimuli added to both praise and correction statements. An adapted alternating treatments design was used to evaluate the two methods of presenting instructive feedback and the students were assessed to determine the extent to which instructive feedback stimuli were learned. Findings indicate: (1) four out of the five students learned their target skills and some of the instructive feedback stimuli with the constant time delay and instructive feedback; (2) the percent of errors displayed by all subjects was higher than typically reported when the constant time delay was used with discrete responses and preschool children with disabilities; (3) no consistent differences in the effectiveness of the two presentation methods were noted; and (4) the students appeared to learn that the two stimuli presented during the feedback event were equivalent. (Contains 27 references.) (Author/CR)

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Instructive Feedback: A Comparison of Simultaneous and Alternating Presentation of Non-Target Stimuli

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Abstract

Instructive feedback involves presenting extra, non-target stimuli in the consequent events for children responses. Two methods of presenting instructive feedback during direct instruction were compared. These methods involved presenting two extra stimuli on all trials, and presenting the two extra stimuli separately on alternating trials. Preschool students were taught coin combinations using a constant time delay procedure with instructive feedback stimuli added to both praise and correction statements. An adapted alternating treatments design was used to evaluate the two methods of presenting instructive feedback. The students were assessed to determine the extent to which instructive feedback stimuli were learned. The results indicate that students learned some of the instructive feedback stimuli and no consistent differences in the effectiveness of the two presentation methods were noted. Further, relationships between the two instructive feedback stimuli appeared to be established. Implications for instruction and future research are discussed.

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Instructive Feedback: A Comparison of Simultaneous and Alternating Presentation of Non-Target Stimuli

In an era of educational reform, teachers must ensure that their methods are effective and efficient. One measure of efficiency is whether teaching strategies provide opportunities for learning extra information that leads to broader knowledge (Wolery, Ault, & Doyle, 1992). A strategy that enables students to learn behaviors that are not taught directly and that requires negligible additional instructional time and effort would be deemed efficient.

To increase the efficiency of instruction, several studies have used a procedure called instructive feedback. Instructive feedback involves presenting additional, nontarget information (stimuli) in the consequent events of direct instructional activities. After acquisition is achieved on target responses, students are assessed to determine whether they acquired the information presented through instructive feedback. Instructive feedback has been used with secondary-aged students who had moderate to severe mental retardation (Doyle, Gast, Wolery, Ault, & Farmer, 1990), elementary-age children with moderate mental retardation (Gast, Wolery, Morris, Doyle, & Meyer, 1990), elementary-age students with mild mental retardation (Gast, Doyle, Wolery, Ault, & Baklarz, 1991), preschool students with communication and hearing impairments (Werts, Wolery, Holcombe-Ligon, Vassilaros, & Billings, 1992), and preschoolers with developmental delays and moderate mental retardation (Wolery, Holcombe-Ligon, Werts, & Cipolloni, in press). In each of these studies, one stimulus for each target behavior was presented through instructive feedback. In two studies with elementary-aged students with mild handicaps, two stimuli were presented through instructive feedback for each target behavior. Gast, Doyle, Wolery, Ault, and Baklarz (1992) used instructive feedback to deliver one or two extra stimuli to photo naming of places in the community. The extra stimuli were either the address or the activity that occurred in each place. When the address was presented alone, students learned it; however, when the address and activity were presented together, they only learned the activity. When two activities were presented, they learned both. Harrell, Wolery, Ault, DeMers, and Smith (1992) also presented two stimuli for each target behavior through instructive feedback. Students were taught to say an antonym, and they were shown the written word and told a brief definition. Most students learned some of both; however, reading the word occurred at higher percentages than stating the definition.

Questions remain about how to present multiple stimuli through instructive feedback and about how many behaviors can be presented. For older students, it has been reported that 6 to 8 items or "chunks" were the optimum number of facts that could be learned efficiently (Deese & Hulse, 1967; Miller, 1956). Furukawa (1970) found that college students learned foreign words more efficiently in "chunks" of seven words. Johnson, Gersten, and Carnine (1987) used computer aided instruction to introduce vocabulary and found that students who learned three words at a time with periodic reviews learned more effectively than those who saw all 25 words in the list at one time. Gleason, Carnine, and Vala (1991) studied the efficiency of rapid introduction of items versus cumulative introduction. They used seven "chunks" of information with elementary students with learning disabilities and found more efficient learning when three "chunks" were presented in a group and then reviewed, rather than presenting all seven and reviewing. No studies

were found that addressed the amount of information optimum for simultaneous presentation with preschoolers and, specifically, preschoolers with identified disabilities.

When instructive feedback was used with preschoolers who had disabilities, they learned both the target behaviors and some of the instructive feedback stimuli (Werts et al., 1992; Wolery et al., in press). However, in both studies, only one stimulus for each target behavior was presented through instructive feedback, and none of the instructive feedback studies (regardless of student age) addressed methods of presenting two stimuli for each target behavior.

In this study, two stimuli for each target behavior were presented through instructive feedback on instructional trials. The two stimuli were presented through two methods (a) the two stimuli were shown simultaneously on one card for each trial (simultaneous presentation), and (b) the two stimuli were shown separately on alternating trials (alternating presentation). The research questions asked were: (a) Will preschool students with identified handicaps learn to name the values of coin combinations (target behavior) and the stimuli presented through instructive feedback?; and (b) Will they learn more if the instructive feedback are presented simultaneously on every trial or separately on alternating trials?

Methods

Participants

Five students (2 girls and 3 boys) from a classroom for preschool children with language delays and/or hearing impairments participated in the study. They ranged in age from 55 to 61 months at the onset of the study. Four of the children were identified as speech/language delayed and one as hearing impaired. One student had a hearing aid and was identified as having a mild to moderate loss. All were verbal and responded to verbal instructions from the investigator.

Emily was a 4-year-11-month caucasian girl from a lower-middle income home. She was enrolled in the program due to speech/language delays. Testing within 1.5 years of the onset of the study found her expressive language to be limited to approximately 20 words. She communicated by gesturing and pointing. She received a score of 96 on a Stanford-Binet Intelligence Test (Terman & Merrill, 1973) (basal at III and ceiling at IV-6), failing only items that required a verbal response; she passed Picture Naming at the III level. Her fine motor skills were age-appropriate, but she exhibited a mild gross motor delay in that she did not pedal a tricycle or alternate feet when walking up stairs. Her eyesight and hearing were within the normal ranges for her age. On the Test of Visual Motor Integration (Beery, 1967), she scored in the average range. On the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1985), her adaptive score was 80, or moderately low. Expressive language, as measured by the Expressive One-Word Picture Vocabulary Test (Gardner, 1979), was at the 8th percentile and her score on the Khan-Lewis Phonological Analysis (Khan & Lewis, 1986) was at the 4th percentile. She exhibited many speech substitutions and omissions. She was given a Wechsler Preschool Primary Scale of Intelligence-Revised (WPPSI-R) (Wechsler, 1974) immediately prior to the onset of the study and received a

Performance IQ of 109, a Verbal IQ of 110, and a full scale IQ score of 111.

Matthew was a 4-year-7-month African American boy from a lower-middle income home. He had been placed in the preschool due to hearing and language problems. He used an amplification device in the classroom (Phonic Ear), and the adults in the class wore a microphone to facilitate his communication. He had been diagnosed as having a mild to moderate impairment in his right ear, with mixed conductive sensorineural hearing loss in the mid- to high-frequency range. He could hear normal speech but had difficulty with background noises and soft or high speech sounds. He was adept with the use of his hearing aid. He was given a WPPSI-R at the onset of the study and received a Performance IQ of 94, a Verbal IQ of 97, and a full scale IQ score of 95.

Kevin was a 5-year-1-month caucasian boy from a lower-middle income home. He was described as having an expressive language delay. He had a moderate to severe articulation disorder and spoke primarily in vowels. His receptive language, as measured by the Peabody Picture Vocabulary Test-Revised (PPVT-R) (Dunn & Dunn, 1981), was at 42 months which is in the 55th percentile for his age yielding a language IQ of 102. The Preschool Language Scale (PLS) (Zimmerman, Steiner & Evatt, 1969) yielded a verbal age of 27 months, and his articulation age level from the Goldman-Fristoe Test of Articulation (Goldman & Fristoe, 1986) was 24 months. His receptive language on the Goldman-Fristoe was at 45 months. He was given a WPPSI-R at the onset of the study and received a Performance IQ of 118, a Verbal IQ of 116, and a full scale IQ of 120.

Luke was a 4-year-8-month caucasian boy from a middle-income home. He was enrolled due to speech and phonology delays. His records noted achievement of normal developmental milestones for walking (11.5 months) and first word (10 months), and testing at 42 months yielded age-appropriate scores in all areas except speech and phonology. On the PLS, he scored 31 months with only occasional two word utterances; and on the PPVT-R, he scored in the 22 percentile (low average). His articulation was below the 2.5 year range. He was given a WPPSI-R at the onset of the study, and received a Performance IQ of 76, a Verbal IQ of 79, and a full scale IQ of 75.

Megan was a 4-year-9-month caucasian girl from an upper-middle class home. She had initially presented with decreased use of her right hand and delayed speech. She suffered a stroke prenatally and had an area of encephalomalacia in the left middle cerebral artery. At 2 years of age, her receptive language was rated as "good" and expressive language as "poor." At 40 months, her language age as measured by the PPVT-R lagged by 12 months. She was given a WPPSI-R at the onset of the study and received a Performance IQ of 94, a Verbal IQ of 91, and a full scale IQ score of 91.

Initially, the students were placed in two groups for instruction. Emily, Matthew, and Kevin composed the triad; Luke and Megan composed the dyad. Each student was screened for the following skills: sitting at a table for 10 minutes or longer, following verbal directions, and making eye contact with the teacher; counting by rote to at least 6; counting 2- and 3-dimensional objects to at least 5; and performing an identity match for written numerals and for written number words. Luke and Megan (the dyad) could rote count to at

least 6, count objects to 5, and match all the stimulus words and numerals to a sample. Emily, Matthew, and Kevin (the triad) could rote count to 14, count objects to 14, and match written words and numerals to samples. Also, all students were trained to wait for a prompt from the examiner before answering the question, and they were all verbally imitative.

Setting

The study occurred in a classroom for children with language delays and hearing impairments that contained 13 students and 2 teachers. A volunteer frequently was present. Two experimental sessions were conducted each day by a member of the research team (hereafter called the instructor). Instruction occurred in the classroom (7 x 11m) at either the activity or speech table (1 x 3m). The students sat facing the instructor with their backs to the classroom. The first session occurred during the morning activity time; and the second occurred immediately following lunch and prior to rest time. Students not involved in the study participated in regular classroom activities with one of the teachers or the classroom volunteer. Three individuals served as instructors; one for the first 8 of days of training, another for 3 days, and the third for the remainder of the study. This was necessary due to the resignation of a member of the research staff.

Materials

Two types of instructional materials were used during instruction: target stimuli and instructive feedback stimuli. For all children, the target stimuli were white cards (7 x 13cm) with coins (pennies, nickels, and dimes) taped on them. The instructive feedback stimuli also were white cards (7 x 13cm) but varied by group and condition. For the triad in the simultaneous condition, the instructive feedback stimuli were cards with pennies taped to them and with a number word written in lower case letters with a blue marker. For the triad in the alternating condition, the instructive feedback stimuli were cards with pennies taped to them and cards with a number word written in lower case letters in blue marker. For the dyad in the simultaneous condition, the instructive feedback stimuli were cards with the numeral and number word written in lower case letters in blue marker; for the alternating condition, the instructive feedback stimuli were cards with the numeral and cards with a number word written in lower case letters in blue marker. The target and instructive feedback stimuli are shown in Table 1. During instruction, children received marks on a tally sheet for correct responses. The sheets contained each child's name in large letters and circles equaling half the number of trials for each student. For each circle with two marks, the students were allowed to select an edible from an array of choices.

Insert Table 1 about here

Materials used during assessment of instructive feedback stimuli were separate white cards (7 x 13cm) with number words written on them, (triad and dyad), pennies taped to them (triad), and written numerals (dyad). For the matching task with the triad, a manilla strip (15 x 30cm), with three white cards affixed, was used. Coins were taped to the three

cards in the following combinations: (a) the correct number of pennies; (b) the same number of coins as the target stimuli, but of different value; and (c) a combination that included some of the same coins as the target coin combinations.

Procedures

General procedures. Initially, all students were screened to identify unknown stimuli. The target stimuli were divided into two sets. Prior to instruction, two probe conditions were implemented. The first assessed students' performance on target behaviors and the second assessed their performance on instructive feedback stimuli. Instruction was then implemented in two separate daily sessions (counterbalanced for time of day), one with each set of target stimuli. With one set, two instructive feedback stimuli for each target behavior were presented on each trial; with the second set, two instructive feedback stimuli for each target behavior were presented separately on alternating trials. After criterion performance was established (3 consecutive days at 100% unprompted correct responses), instructive feedback probe sessions were implemented.

The triad was taught to name the values of coins (nickel) or coin combinations (nickel or dime and pennies). Their instructive feedback stimuli consisted of the written word for the value of the coin combinations and an array of pennies equal to the value of the combinations. They were instructed in a 1:3 arrangement until Emily reached criterion. The two remaining students remained together for one session and then were instructed individually. The instructor presented the group with 24 trials per session (4 trials x 2 stimuli for each child). For the individual sessions, each student received 8 trials (4 trials x 2 stimuli). Instruction was continued until each student reached criterion in both conditions.

The dyad were taught to recognize and to name expressively an array of pennies. Their instructive feedback stimuli were the numerals and the written number words corresponding to the coin combinations. The instructor delivered 16 trials per session (4 trials x 2 stimuli for each child). The stimuli differed for the two groups due to the differing initial abilities of counting, money, and coins.

Probe condition procedures. Prior to instruction, each student was tested to ensure that the stimuli to be taught were unknown. Three sessions were conducted over three days. In each session, the child was asked to state expressively the value of the coin combinations. The instructor presented an attentional cue ("Ready," or "Look," etc.), and, if the child responded affirmatively, the instructor said "How many cents?" and provided a 4-second response interval If the child responded correctly, the instructor praised the child. If a no response or error occurred, the instructor gave a nonjudgmental response such as "OK" or "We'll learn that later." A 2-5 second intertrial interval was used.

Instructive Feedback probe procedures. Instructive feedback probe sessions assessed children's acquisition of the instructive feedback stimuli. These sessions were conducted individually before the instructional condition and after children achieved criterion level performance. For the triad, three measures were collected over four sessions; these were (a) the percent of correct responding to an expressive number-word reading task (i.e., test of

acquisition of the instructive feedback stimuli), (b) the percent of correct matching of the target coin combinations to the number of pennies in a 3-choice format (test of acquisition of the instructive feedback stimuli), and (c) percent of correct matching of the number word to the number of pennies in a 3-choice format (test of relationships between the two instructive feedback stimuli). For the number-word reading task, the instructor presented an attentional cue ("Look." or "Ready?"), ensured that the child looked, provided the task direction ("What's this?"), provided a 4-second response interval, praised correct responses, and ignored incorrect responses. For the matching tasks, the instructor placed the three-choice array in front of the child, provided an attention cue ("Look"), ensured that the child looked, gave the child a stimulus to match, and said, "Find the same." A 4-second response interval followed. Correct responses were praised and errors were ignored.

The students in the dyad were asked to expressively and receptively identify the instructive feedback stimuli (numerals and words corresponding to the value of the penny arrays). These sessions tested the acquisition of the instructive feedback stimuli. They also were asked to match arrays of pennies to the numerals and the written words (4-choice format). Each measure was assessed in four sessions. The procedures used were identical to those used with the triad.

Instructional procedures. A 4-second constant time delay procedure with instructive feedback was used. Constant time delay involves two types of trials: 0-second and delay trials. The 0-second trials involve presentation of the task direction followed immediately by a controlling prompt (i.e., one that ensures the child responds correctly). In this study, the instructor ensured that the student was attending, presented the card and the task direction ("How many cents?"), and immediately presented a verbal model of the correct response. The student then imitated the correct response. The instructor immediately showed a second card containing the instructive feedback stimuli and said, "This is also (number)." No response was required from the child and no consequence was attached to the instructive feedback. For each correct response to the target stimuli, the instructor praised the child, and marked a line on the reinforcer tally sheet. Children selected one edible for each of two marks on the tally sheet at the end of the session.

Starting with the second session, 4-second delay trials were used. These trials were identical to the 0-second trails with two exceptions. First, a 4-second response interval was inserted between the task direction and controlling prompt. Second, at the beginning of the session, the children were told to respond if they knew the answer but to wait if they did not. Consequences for correct responses were identical to those for the 0-second trials. If an error or no response occurred, the instructor modelled the correct response and allowed the child to imitate. The instructive feedback stimuli were presented following all responses. Five responses to the target stimuli were possible. The students could answer correctly before the prompt--unprompted corrects, answer correctly after the prompt--prompted corrects, answer incorrectly before the prompt--unprompted errors, answer incorrectly after the prompt--prompted errors, or give no response.

Experimental design

An adapted alternating treatments design was used (Sindelar, Rosenberg, & Wilson, 1985). It is a variation of the alternating treatments design in which treatments are applied to independent but equally difficult behaviors. Two sets of coin combinations (two per set) were assigned to each subject. Baseline probes determined that the sets were unknown. One set was taught using constant time delay and simultaneous presentation of the two instructive feedback stimuli on each trial, and the second set was taught using constant time delay and alternating presentation of the two instructive feedback stimuli for each target behavior. One session for each condition occurred each day counterbalanced for time of day.

Reliability

Interobserver agreement assessments occurred for the dependent measure, and procedural fidelity checks also were conducted (Billingsley, White, & Munson, 1980). The following behaviors were assessed for procedural fidelity: ensuring student attention, presenting the task direction, waiting the response interval, providing the model, delivering the instructive feedback, and waiting the intertrial interval.

Results

Reliability

During instructional sessions, interobserver agreement data were collected for 25% of the sessions for Kevin, 15% for Matthew, 9% for Emily, 19% for Megan, and 25% for Luke. Interobserver agreement data were collected in 47% of the initial probe sessions and 15% of the final probe sessions. Interobserver agreement percentages were calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. In all initial probe sessions, the percentage of agreement was 100. The percentage of agreement during the simultaneous condition was 99.5 (range 98.2-100); for the alternating condition, the percentage was 98.9 (range 96.8-100). For the final probe sessions, the percent of agreement was 97.9 (range 83.3-100).

Procedural reliability was calculated by dividing the number of actual teacher behaviors in each category by the number of planned behaviors and multiplying by 100. The percentage of compliance with the procedures was 100 on all categories except waiting the correct number of seconds (97.9% in alternating condition for Kevin), giving the correct prompt (97.9% in alternating condition for Kevin), praising the correct response (87.5% in the alternating condition for Matthew), and presenting the instructive feedback (93.7% in the simultaneous condition for Matthew, 96.8% in the alternating condition for Luke, and 97.9% in the alternating condition for Megan).

Effectiveness

Triad. The constant time delay procedure was effective in teaching all three students to name values of coin combinations. Emily met criterion in 11 sessions for the

simultaneous condition and in 9 sessions for the alternating condition. Matthew reached criterion in 20 sessions for the simultaneous and in 9 sessions for the alternating condition. Kevin reached criterion in 13 sessions for the simultaneous and in 23 sessions for the alternating condition.

Dyad. The students in the dyad were taught to state the value of arrays of pennies. Megan met criterion in 36 sessions for the simultaneous condition and 35 sessions for the alternating condition. She required several modifications during the study including additional training in waiting for the prompt, specific attentional cue that required her to match the stimulus card to a sample before responding, and differential reinforcement of unprompted and prompted correct responses. A touch cue was added but she abandoned it after the session in which it was modeled and began responding at a 100% correct level.

The constant time delay procedure was not effective in teaching Luke to name values of pennies to the pre-set criterion level. Luke's target task was to state the value of arrays of pennies (8, 9, 10, and 11). He displayed highly variable unprompted correct performance. When he was presented with only two stimuli in instruction, he would verbally rehearse and respond correctly more often when he saw the same stimuli repeated. He would respond before looking at the stimuli unless reminded both verbally and gesturally. He could not always remember the names of the edibles used for reinforcers and had to point to indicate what he wanted (M & M's and pretzels). Various procedural modifications were implemented throughout the investigation for Luke. These modifications included: (a) using a match-to-sample attending cue, (b) teaching individually instead of in the dyad, (c) delivering reinforcement only for correct unprompted responses and using trial-to-trial reinforcement, and (d) using two of the stimuli and teaching one stimulus for the simultaneous and one from the alternating condition in each daily session. These modifications resulted in increased correct responding and some sessions of 100% correct unprompted responding, but Luke did not achieve criterion. He was assessed during the last sessions of the school year to evaluate the acquisition of instructive feedback stimuli.

Efficiency

Efficiency measures included the number of sessions to criterion, number and percent of errors during training, and the percent of correct responding on the instructive feedback probe sessions. The number of instructional sessions through criterion are shown in Table 2. Substantial variability existed in the number of sessions required to achieve criterion in the two conditions. However, consistent differences in favor of either condition did not occur.

Insert Table 2 about here

The number and percentages of errors are shown in Table 3. They ranged from 6.7% to 29.1% for the four students who achieved criterion. Luke's errors ranged as high as 42.9%. The total percentages of errors for the Triad was 10.2%. The total for the Dyad was 28.2%.

Insert Table 3 about here

Performance on the instructive feedback stimuli for the triad was assessed by (a) expressive reading of the number words, (b) matching the coin combinations to the correct number of pennies (3-choice format), and (c) matching the written word to the correct number of pennies (3-choice format). The mean percent of correct responses on instructive feedback measures are shown in Table 4. For the triad, each acquired some of the instructive feedback stimuli. An analysis of differences for the three measures for the three students (9 comparisons) showed the simultaneous presentation resulted in higher percentages of correct responses in four instances, the alternating presentation resulted in higher percentages in four instances, and levels were equal in one instance.

Insert Table 4 about here

The percentages of correct responses by measure across students were compared. Matching the written word to pennies resulted in 68.75% correct responding compared to 47.91% for matching coin combinations to pennies and 37.5% for expressive identification of words. Higher levels of performance occurred on the tasks requiring a forced-choice format than expressive recall.

For the forced choice tasks for the triad, the highest level of response on the non-target probes was shown on the task that required the students to match one instructive feedback stimulus to the second instructive feedback stimulus. These percentages were greater than those for direct tests of acquisition on the instructive feedback stimuli.

The students in the dyad (Megan and Luke) were assessed on receptive and expressive identification of the instructive feedback stimuli and on matching the target stimuli to the numerals and written words (4-choice format). These measures were collected across four sessions. The data for Megan indicate that she learned to identify the numerals both receptively and expressively for both conditions, scoring at 100% on all numerals in the final three probes. She learned to read some of the words. Overall comparison of the means for simultaneous and alternating conditions indicates no systematic differences between the two conditions. She was able to match pennies (target) to words (87.5%) and to match pennies to numerals (100%). Luke did not achieve criterion level responding on the target behavior, but he was assessed on the instructive feedback stimuli. His responding during these probe sessions appeared random with the percent of correct responses below 50.

Discussion

The purpose of this study was to compare two methods of presenting multiple instructive feedback stimuli during direct instruction. The two methods involved presenting

two instructive feedback stimuli for each target behavior on every trial and presenting the two stimuli for each behavior separately on alternating trials. From this study, four conclusions can be drawn. First, constant time delay and instructive feedback were effective with 4 of the 5 students. A recent review of the research with constant time delay and discrete tasks indicated that the procedure was effective with 97.7% of the subjects who had been taught with the procedure in 36 studies (Wolery, Holcombe, et al., 1992). Thus, Luke is one of the few cases where the procedure has not been effective. Several factors, separately or in combination, may have contributed to this lack of effectiveness. He had little experience with direct instruction, the task he was taught was difficult based on his entry level skills, he tended to respond quickly, and he tended to provide the same response despite stimulus changes across trials. Also, the presentation of two instructive feedback stimuli may have contributed to the procedure's lack of effectiveness for Luke. The other students each learned their target skills and some of the instructive feedback stimuli. The percentage of correct responding for these subjects on instructive feedback probe sessions was above chance levels for both instructive feedback presentation methods.

Second, the percent of errors displayed by all subjects was higher than typically reported when the constant time delay procedure was used with discrete responses and preschool children with disabilities (Wolery, Holcombe, et al., 1992). Possible explanations for this are the subjects' inexperience with direct instruction, the difficulty of the task, and the presentation of the multiple instructive feedback stimuli. Previous research has compared the rapidity of children's learning with and without instructive feedback (e.g., Holcombe-Ligon, Wolery, Werts, & Hrenkevich, 1992; Wolery, Doyle, et al., 1991). This research indicates that children learned more rapidly when one extra stimulus was provided in the feedback events. Future research should compare the effects of teaching three sets of stimuli sequentially rather than teaching one stimulus set while presenting two stimuli through instructive feedback.

Third, and most central to the purpose of this study, it appears that no consistent differences occurred between the two methods of presenting instructive feedback stimuli (i.e., simultaneous and alternating). The subjects who acquired their target behaviors performed similarly on the instructive feedback stimuli that were presented through the two methods. Two previous studies have used the simultaneous method of presenting two pieces of information (Gast et al., 1992; Harrell et al., 1992). In the Gast et al. study, two types of instructive feedback stimuli were presented and students learned one type to the exclusion of the other. When two stimuli of the type they had learned were presented through instructive feedback, they learned both equally and completely. In the Harrell et al. study, two types of stimuli also were presented, and both types were learned, but one was acquired at higher levels than the other. Megan's results are consistent with the Harrell et al. investigation; that is, she named the numerals at higher levels than she read the number words. This was not consistently the case with Emily, Kevin, and Matthew, possibly due to the fact that reading words and recognizing the value of arrays of pennies were of equal difficulty. Thus, it appears that the method of presentation had less effect than the type or difficulty of the stimuli.

Fourth, the subjects appeared to learn that the two stimuli presented during the feedback events were equivalent. The children in the triad were able to match the written number words with the number of pennies at percentages higher than chance (cf. Table 4). Interestingly, the amount of correct performance on this task was not related to the method of presentation. In the simultaneous presentation format, the two stimuli (i.e., number word and pennies) were presented on the same card. However, in the alternating presentation format, the two stimuli were not presented together, but were presented separately on alternating trials. This suggests that the acquisition of the target behavior may have mediated the acquisition of the equivalence of the two stimuli.

The implication of these findings for teachers is threefold. First, when two extra stimuli are presented through instructive feedback, students may acquire some of that information. Second, students may learn that the two instructive feedback stimuli are equivalent. Thus, using instructive feedback is recommended as is using multiple instructive feedback stimuli. Third, teachers can use either simultaneous or alternating presentation of the instructive feedback stimuli. However, these statements are made with several qualifications and limitations. The students in this study had mild disabilities, general intellectual functioning in the normal range (as measured by intelligence tests), relatively mild delays in the curricular area being studied, imitative abilities, the ability to perform identity matches on the stimuli used, and identified reinforcers. We expect the findings to be more likely replicated with subjects who display similar demographics and skills than those who do not. These subject characteristics are similar to the previous studies that investigated acquisition of two instructive feedback stimuli (Gast et al., 1992; Harrell et al., 1992). Despite this qualification, instructive feedback appears to be a robust procedure because it has been effective with preschoolers who have more substantial disabilities (Wolery et al., in press), and elementary (Gast et al., 1990; Wolery, Doyle, et al., 1991) and secondary students with moderate mental retardation (Doyle et al., 1990). Whether presentation of two stimuli through instructive feedback would be effective with these populations remains an issue for further investigation.

These preschool-aged children had IEP's in the areas of speech and language delays and one child had a mild to moderate hearing loss corrected with amplification. As such, their tested skills prior to the implementation of the procedures were fairly high on these numerical and quantitative tasks. Numerical tasks were selected to avoid areas that had been shown to be a deficit for any of the children, to provide a pool of tasks that were discrete in nature, and to teach in an area that the teacher reported was important and was on the children's IEPs but was not being addressed in the classroom at the time of the study.

In terms of future research, several issues deserve study. First, no study has investigated the extent to which presenting two stimuli for each behavior through instructive feedback interferes with the acquisition of the target stimuli. Previous research of adding one extra stimulus indicates that acquisition of the target stimulus is not negatively affected (Holcombe-Ligon et al., 1992; Wolery, Doyle, et al., 1991). However, the high error percentages in the present study indicate that presenting two stimuli for each target behavior through instructive feedback may interfere with the acquisition of target behaviors. Clearly, this issue deserves more study. Second, future research should address whether students

learn higher levels of the instructive feedback stimuli when they are repeatedly taught and tested using this format. In the present study, the children learned one set of stimuli with simultaneous presentation and the other set with alternating presentation. It would be useful to know whether learning multiple sets with either presentation format would result in learning to learn two extra stimuli for each target stimulus. Third, the effects of intermittently testing students during instruction on their acquisition of stimuli presented through instructive feedback should be evaluated by future research. It is possible that such testing would cause more attention to, and thus more learning of, the instructive feedback stimuli. Finally, future research should investigate what types of extra stimuli are most readily learned when presented through instructive feedback. Some types of stimuli may be acquired more quickly than other types (Gast et al., 1992; Harrell et al., 1992).

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Table 1

Target and Instructive Feedback Stimuli

Student	Simultaneous		Alternating		
	Target[a]	Instructive Feedback	Target[a]	Instructive Feedback	
Triad					
Emily	D-P-P	"twelve"/12 pennies	N-P	"six"	6 pennies
	N	"five"/5 pennies	N-N	"ten"	10 pennies
Matthew	N	"five"/5 pennies	N-N	"ten"	10 pennies
	N-P-P-P	"eight"/8 pennies	N-P-P	"seven"	7 pennies
Kevin	N-P-P-P	"eight"/8 pennies	N-P-P	"seven"	7 pennies
	D-P	"eleven"/11 pennies	N-P-P-P-P	"nine"	9 pennies
Dyad					
Luke	9 pennies	"9"/"nine"	8 pennies	"8"	"eight"
	11 pennies	"11"/"eleven"	10 pennies	"10"	"ten"
Megan	9 pennies	"9"/"nine"	8 pennies	"8"	"eight"
	11 pennies	"11"/"eleven"	10 pennies	"10"	"ten"

[a] D = dime, P = penny, and N = nickel

Table 2

Number of Sessions of Training Through Criterion

Student	Simultaneous	Alternating
Emily	11	9
Matthew	18	11
Kevin	16	28
Megan	36	35
Luke[a]	(36)	(36)
Totals	117	119

[a] Luke did not reach criterion level responding.

Table 3

Number and Percentage of Errors During Training

Student	Simultaneous		Alternating		Total	
	Number	Percent	Number	Percent	Number	Percent
Emily	13	14.7	7	9.7	20	11.3
Matthew	18	11.8	24	15.8	42	13.8
Kevin	14	6.7	17	7.5	31	7.1
Totals	45	10.0	48	10.3	93	10.2
Megan	51	17.7	84	29.1	135	23.4
Luke[a]	(65)	(22.5)	(127)	(42.9)	(192)	(32.8)
Totals	116	20.1	211	36.1	327	28.2

[a] Luke did not reach criterion level responding.

Table 4
Percent of Correct Responding on Instructive Feedback Measures After Training

Measure (Purpose) / Subject	Presentation of Method	
	Simultaneous	Alternating
Expressive Reading of Number Word (Test Acquisition of Instructive Feedback Stimuli)		
Emily	37.5	50.5
Kevin	0.0	75.0
Matthew	37.5	25.0
Megan	66.6	45.8
Matching Coin Combination to Number of Pennies (Test Acquisition of Instructive Feedback Stimuli)		
Emily	12.5	12.5
Kevin	50.0	37.5
Matthew	75.0	100.0
Matching Written Word to Number of Pennies (Test Existence of A Relationships Between Two Instructive Feedback Stimuli)		
Emily	62.5	50.0
Kevin	62.5	50.0
Matthew	87.5	100.0
Expressive Naming of Numerals (Test Acquisition of Instructive Feedback Stimuli)		
Megan	87.5	87.5